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High broadband spectral resolving transition-edge sensors for high count-rate astrophysical applications

We are developing arrays of transition-edge sensor (TES) X-ray detectors optimized for high count-rate solar astronomy applications where characterizing the high velocity motions of X-ray jets in solar flares is of particular interest. These devices are fabricated on thick Si substrates and consist of $35 \times 35 \mu\text{m}^2$ TESs with 4.5 μm thick, 60 μm pitch, electroplated absorbers. We have tested devices fabricated with different geometric stem contact areas with the TES and surrounding substrate area, which allows us to investigate the loss of athermal phonons to the substrate. Results show a correlation between the stem contact area and a non-Gaussian broadening in the spectral line shape consistent with athermal phonon loss. When the contact area is minimized we have obtained remarkable broadband spectral resolving capabilities of $1.3 \pm 0.1 \text{ eV}$ at an energy of 1.5 keV, $1.6 \pm 0.1 \text{ eV}$ at 5.9 keV and $2.0 \pm 0.1 \text{ eV}$ at 8 keV. This, coupled with a capability of accommodating 100's of counts per second per pixel makes these devices an exciting prospect of future x-ray astronomy applications.